

# MONTHLY WEATHER REVIEW,

## JANUARY, 1877.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

### INTRODUCTION.

In compiling the present REVIEW, the usual data received up to February 14th have been made use of. The most noticeable features for the month are: The severe coast storm of the 1st and 2nd; the increasing severity of storms as they approached the Gulf of St. Lawrence; the continuance of the cold weather of December until after the middle of ~~January~~, giving low average temperatures for the districts east of the Rocky Mountains; generally, a deficiency in the precipitation; the destructive ice-gorges in Ohio and Monongahela rivers; the closing of many harbors by ice, from the Potomac northeastward, until after the middle of the month.

### BAROMETRIC PRESSURE.

The general distribution is represented upon Chart No. II. The highest reading for the month, 30.91 in., was observed at Breckenridge, night of the 11th, during the advance of high pressure No. III; lowest, 28.76 in., at Sydney, 11 p. m., 2nd. The average of the barometric readings at Fort Sully is 30.16 in.

*Ranges in Barometer.*—Portland, Or., 0.95 in.; San Francisco, 0.81; San Diego, 0.41; Rocky Mountain stations, 0.65 to 1.54; plains of Nebraska and Kansas, 1.39 to 1.56; northern Texas and Indian Ty., 1.10 to 1.24; Missouri valley, 1.14 to 1.31; Red River of the North valley, 1.29 to 1.38; Upper Miss. valley, 0.90 to 1.27; Upper Lake region, 0.87 to 1.35; Lower Lake region, 1.03 to 1.28; Ohio valley and Tenn., 0.98 to 1.24; New England, 1.42 to 1.75; Middle States, 1.05 to 1.49; South Atlantic States, 0.86 to 1.16; Gulf States, 0.75 to 1.10; Key West, 0.51.

*Areas of High Pressure.*—During the first part of the month they were more frequent than during the last part. The high-pressure area, designated as No. IX in the December Review, and central over Tenn., on the morning of the 31st, covered the Middle States morning of the 1st, but with diminished pressure, after which it rapidly disappeared in advance of No. I.

No. I.—It was observed morning of the 1st in the Northwest, with minimum temperatures from 25° to 29° below zero in the Red River of the North valley. Snow fell in central Dakota. By morning of the 2nd the pressure had increased, with a barometric reading of 30.73 in. at Yankton. The area of 0° minimum temperature extended into the eastern portions of Nebraska and Kansas, Missouri, Illinois, Indiana and Wisconsin. During the day it moved southward, and, at 7:35 a. m. of the 3rd, was central in northern Texas, producing a light "norther" on the coast. From Tennessee northeastward over the central portion of the Middle States, in the St. Lawrence valley and northern New England, the temperature fell below 0°. On the morning of the 4th it covered the Southern States, with diminished pressure, being central in Alabama. The minimum temperature continued below 0° from the St. Lawrence valley and New England to the central portion of the Middle States. By the following morning, in advance of low pressure No. II, it moved to the South and Middle Atlantic coasts, with continued cold weather in the Atlantic States. During the 5th and 6th it gradually disappeared northeastward along the coast.

No. II.—During the day and night of the 6th, in rear of low pressure No. III, it advanced southeastward over the Northwest. At Breckenridge the temperature fell from 24° to -18° within twenty-four hours. High northwesterly winds were produced in Dakota and Minnesota, reaching 70 miles per hour at Pembina. The 7th, it rapidly extended south and eastward, with a decided fall in the temperatures. Morning of the 8th it was central in Indian Territory. Minimum temperatures from 20° to 32° below zero were reported from Dakota and Minnesota, and below zero from the Upper Lakes to Kansas and Missouri. A very severe "norther" was produced, reaching 44 miles at Indianola and 62 at Galveston, in connection with low pressure No. IV, and for which Cautionary Signals had been ordered the evening of the 7th. The

temperature fell  $38^{\circ}$  in two hours at Melissa, Texas. At 7:35 a. m., 9th, it reached from Louisiana to Ohio and the Virginias; excepting a few stations along the Texas, South Atlantic and Nova Scotia coasts, the temperatures had fallen below freezing, and below zero from Tennessee to northern Dakota and the Lakes, and in the northern portions of New York and New England. By morning of the 10th, with increased pressure, and in advance of low pressure No. V, it moved to Nova Scotia and New Brunswick, whence it passed to the eastward during the 10th.

No. III.—At midnight of the 10th it was first felt as progressing southward from Manitoba over Minn. and Dakota, forcing low pressure No. VI to take a more southerly course. Morning of the 11th a minimum temperature of  $-34^{\circ}$  was recorded at Ft. Garry. The pressure continued increasing, reaching a maximum of 30.91 at Breckenridge, by midnight. At 7:35 a. m., 12th, the highest reached from the southern portions of Dakota and Minn. towards Colorado and western Kansas. Minimum temperatures,  $-35^{\circ}$  at Fort Garry, and below zero from Montana, Wyoming, Colorado and western Kansas to the Lakes, in the northern portions of New York and New England, the St. Lawrence valley and Nova Scotia. The temperature fell from  $30^{\circ}$  to  $-20^{\circ}$  in ten hours, on the 12th, at Watertown, N. Y. During the evening a light "norther" commenced on the Texas coast, for which signals had been displayed the evening previous. The temperature fell from  $70^{\circ}$  to  $21^{\circ}$  within 24 hours at Denison, and at New Ulm, Texas,  $31^{\circ}$  from 10 a. m. to 2 p. m. Morning of the 13th it was central in Indian Ty., but was gradually dissipated during the day in advance of storms Nos. VII and VIII.

No. IV.—It appeared, night of the 13th, in Manitoba and northern portions of Dakota and Minn., with a minimum temperature of  $-53^{\circ}$  at Pembina. As storm No. VII passed eastward, it extended southward from Dakota on the 14th, with continued low temperatures in Minn. and Dakota. Afternoon of the 15th it was central in Dakota, and signals were hoisted for a "norther" from Indianola to Mobile. At the former a velocity of 44 miles was recorded; at Galveston, 40; those for New Orleans and Mobile were reported as not justified. Morning of the 16th it was highest in Indian Ty., in the northern portion of which the temperature fell to zero. During the day its progress was northeastward, and the following morning, with increased pressure, it covered the Middle and Eastern States. Signals were ordered for the North Carolina coast, which were succeeded by high northerly winds. At 7:35 a. m., 18th, it continued over the Middle Atlantic States, after which it moved southward along the coast and disappeared.

No. V.—On the morning of the 17th it was first observed in Dakota, where it was central the following morning, with increased pressure and lower temperatures; maximum barometer 30.71 in. at Ft. Sully and Yankton. During the 18th it moved southeastward, but, by 7:35 a. m., 19th, in advance of storm No. IX, it had lost its distinctive features.

No. VI.—During the afternoon, 19th, it appeared in Dakota, producing high northwesterly winds, and extended southward. At 7:35 a. m., 20th, it was central in Kansas. Signals were displayed for a light "norther" on the Texas coast, which was felt at Galveston morning of the 21st, when this high pressure-area covered the Ohio valley. During the 21st and 22nd it passed to the eastward over the Middle States, New England and Nova Scotia, in advance of low pressure No. X.

No. VII.—On the morning of the 22nd it was central in Dakota and Nebraska; maximum barometer 30.71 in. at Yankton. A light "norther" was produced at night on the Texas coast. At 7:35 a. m., 23rd, it extended from Kansas and Indian Territory towards the Ohio valley. During the day it continued over the country west of the Lower Mississippi valley, whilst storm No. XI was moving eastward, and on the following morning it reached from Dakota to Texas; maximum barometer 30.78 in. at Yankton. Morning of the 25th it was central in Tenn.; 26th, covered the Southern States; 27th, central in Louisiana; 28th, in the Lower Mississippi valley; 29th, in the Gulf States; 30th, united with a high pressure-area which advanced southward from Canada towards the Lake region, and reached from the Eastern Gulf States to the Lower Lakes; 31st, covered the Middle Atlantic and South Atlantic States, and during the day, moved to the South Atlantic coast in advance of low pressure No. XIV.

*Areas of Low Pressure.*—Of these fourteen have been charted. The centres of the majority have passed eastward to the north of the Lake region, while some of them produced only fresh to brisk winds in that section. Those crossing the southern portions of the country, and generally during the first half of the month, were the most severe, especially along the Texas and Atlantic coasts.

No. I.—This storm was designated in the December Review as No. XV. At 7:35 a. m., of the 1st, very cold weather prevailed from the Rocky Mount ins eastward, being below freezing, excepting portions of the Eastern Gulf and South Atlantic States. The heavy rains along the coast changed into heavy snow over the interior, the latter extending during the evening to the Lower Lakes and southern New England, and was followed by colder, clearing weather in the Southern States. During the 2nd, as it moved northeastward along the coast with increasing severity, it was preceded by heavy snow. The following are some of the greatest depths reported, viz: Jacksboro, Texas, 12 in.; Point Pleasant, La., 15; Decatur, Ala., over 17; Hiwassee College, Tenn., 20; Murphy, N. C., 15; Lynchburg, 14; Washington, 13; Cape May, 8; New



York city, 15; Philadelphia, 20; and Chepachet, R. I., 18 inches. Minimum barometer 28.76 in. at Sydney, Nova Scotia, 11 p. m., 2nd. The maximum hourly wind velocities recorded are: Galveston, N. 54 miles; Key West, W. 38; Cape Lookout, NE. 50; Capes Henry and May, NE. 52; Thatcher's Island, NW. 48; and, Mt. Washington, N. 100. Cautionary Signals had been displayed, December 31st, along the Texas coast, and were ordered on the 1st along the Atlantic coast from Georgia to Maine; stations in Nova Scotia, New Brunswick, St. Lawrence valley and Newfoundland were also warned of its approach.

No. II.—Its approach was indicated on the night of the 3rd by diminishing pressure in the Northwest. During the 4th light snows fell from the Lake region to Wyoming and Colorado, partly changing to sleet and rain. On Pike's Peak the wind velocity reached N. 42 miles; at Dodge City, N. 32. The 5th, it moved southward to the Gulf coast, producing frequent light rains in the Gulf States. The 6th, during its progress northeastward, rainy weather prevailed in the Eastern Gulf, South Atlantic and Middle States, partly changing into sleet and snow over the interior, with increasing winds and diminishing pressure. Maximum velocities: At Cape Hatteras, SE. 36; Cape May, E. 44 miles. 7th, the pressure continued diminishing, minimum 28.85 at Boston, with heavy rains along the coast, heavy snow throughout the interior, and increasing winds. At Sandy Hook, SW. 46 miles; New London, W. 40; Thatcher's Island, E. 48; Eastport, E. 36; and Mt. Washington, NW. 96. It disappeared to the northeastward at night. Signals were displayed along the coast from Georgia to Maine, and warnings sent to stations in Nova Scotia, New Brunswick, St. Lawrence valley and Newfoundland.

No. III.—During the 6th it was accompanied by light snows from Dakota to Michigan, and by increasing southerly winds, veering to brisk and high northwesterly, in the Northwest and Upper Lake region, reaching, at Pembina, NW. 70 miles; Milwaukee, NW. 32; Escanaba, S. 28. 7th, it disappeared, as shown on the chart, and probably united with storm No. II. Signals ordered for Milwaukee and Grand Haven were justified.

No. IV.—On the 6th and 7th this storm apparently developed from No. III, in advance of high pressure No. II, and produced occasional rains from the Gulf States to the Ohio valley, turning into snow at night. 8th, generally cloudy weather, with frequent snow, prevailed from Tennessee northeastward to the St. Lawrence valley, New Brunswick and Nova Scotia, changing to rain along the coast. It also increased in severity. Maximum velocities: Kittyhawk, N. 48 miles; Cape May, NW. 44; Sandy Hook, NW. 45; Newport, NW. 35; Thatcher's Island, NW. 36; Eastport, NW. 32. Signals were displayed along the Gulf and Atlantic coasts, all of which were justified by dangerous winds at or in the vicinity of the stations, excepting Mobile, Key West, Jacksonville, Savannah and Charleston.

No. V.—Falling barometer and warmer southeasterly winds indicated the approach of this disturbance, on the afternoon of the 8th, in the Upper Missouri valley, and were succeeded by snow. On Pike's Peak a very severe storm prevailed, with a recorded velocity of NW. 80 miles. 9th, the snow-area extended to the Lakes, Indiana, Illinois and Missouri. The temperature fell 24° in twenty-five minutes at Denver. At 11 p. m. it appeared as a barometric trough, reaching from Lake Superior to Indian Territory. During the 10th it disappeared over Canada. The signals displayed at Grand Haven and Milwaukee were justified.

No. VI.—This storm apparently passed southeastward over Montana on the 10th, producing light rains at Portland, Or., and light rain, turning into snow, at Virginia City. In the Northwest, frequent light snows fell, and high southerly winds were reported from Nebraska; S. 48 miles at North Platte. Its southeastward course was due to the high pressure No. III, which was advancing southward over Manitoba the night of the 10th. At 4:35 p. m., 11th, it appeared as an extensive barometric trough, reaching from northern Texas northeastward over Ohio to the mouth of the St. Lawrence, in which rainy weather prevailed from western Pennsylvania to southern Missouri, but thence north and northeastward stormy and snowy weather. Maximum velocities: at Dodge City, NE. 44; Milwaukee, N. 28; Port Huron, N. 30; Oswego, SE. 30, and Cape May, S. 30. At midnight it appeared as two distinct depressions, central in Arkansas and near Chatham, N. B. The latter passed southeastward into the Atlantic. During the 12th, rainy weather accompanied the former from Tennessee and the Ohio valley to Pennsylvania and New Jersey, and snow thence to the Lakes and New England. A thunder-storm was reported from Mississippi. 13th, it disappeared eastward over New England. Signals were displayed along the coast from North Carolina to Maine, at Milwaukee and Grand Haven, the majority of which were justified. Maximum velocities: Sandy Hook, W. 36; Newport, W. 27; Thatcher's Island, NW. 40.

No. VII.—At San Francisco, high northerly winds, maximum 38 miles, prevailed during the 12th. Rainy weather commenced at San Diego morning of the 13th, accompanied by high winds and hail, and extended into Arizona during the 13th and 14th. On the latter date, light snow fell in Utah, Dakota and Minnesota, and the storm was apparently central, at 4:35 p. m., in southern Colorado, with a heavy snow-storm on Pike's Peak. There were indications of this storm advancing toward the Northwest, but it was forced to take a more southerly course by high-pressure area No. IV. During the 15th, very cold, stormy weather, with snow, prevailed from Colorado, Wyoming and Dakota eastward over the Lake region to New England, and thence southward threatening and rainy weather, with increasing southerly winds. On

the 16th, it passed eastward over New England and south of Nova Scotia, followed by clearing weather. Signals were displayed at Grand Haven, Milwaukee, along the Atlantic coast from Georgia to Maine, and warnings sent to all the Canadian stations. Maximum velocities: Escanaba, N. 36; Milwaukee, NE. 32; Cape Lookout and Hatteras, SW. 36; Thatcher's Island, N. 32; and Eastport, NE. 42.

No. VIII.—During the night of the 12th it advanced southeastward over Manitoba towards the Upper Lakes. The 13th, brisk and high southerly winds, veering to westerly, with occasional snow, accompanied it in Minnesota and the Lake region. During the 14th it passed eastward over the Gulf of St. Lawrence, producing brisk and high southwesterly winds, veering to northwesterly, and snow from the St. Lawrence valley to Nova Scotia. Signals were displayed at Milwaukee and Grand Haven, and continued along the Middle Atlantic and New England coasts. Maximum velocities recorded: Grand Haven, SW. 42; Rochester, W. 36; Father Point, W. 34; Eastport, NW. 36.

No. IX.—On the morning of the 19th this disturbance was felt in Manitoba, Dakota and Minnesota by a decided fall in the barometer. As it progressed southeastward it increased in severity, with brisk and high southerly winds, veering to westerly, and rain, partly changing into snow, in the Lake region. Rainy weather also prevailed in the Southwest and extended to the Ohio valley, Tennessee and the Middle States. The 20th the central depression continued diminishing, with minimum barometric readings of 28.93 in. at Quebec and Father Point. It continued increasing in severity from the Middle States and Lower Lake region northeastward, and disappeared at night. Maximum velocities: Escanaba, SW. 33; Grand Haven, W. 40; Buffalo, SW. 50; Montreal and Quebec, W. 40; Boston, W. 42; New York, W. 36; Cape Lookout, SW. 36; and Mt. Washington, NW. 102. Signals were displayed at Milwaukee, Grand Haven, along the coast from North Carolina to Maine, and all Canadian stations notified.

No. X.—In Minnesota, the Lake region, St. Lawrence valley, New Brunswick and Nova Scotia light snows occasionally fell during its progress eastward, and fresh to brisk winds prevailed. The only high wind reported was from Grand Haven, W. 35 miles, and for which signals were not ordered. A slight depression (not charted) appeared on the Gulf coast on the 21st, producing heavy rains, and at Galveston a very brisk wind, N. 28 miles. Thunder-storms were occasionally reported from Tex., La., Fla., Ga. and S. C. During the 22nd it apparently passed off the South Atlantic coast, with rainy weather in the South Atlantic States, and brisk to high northeasterly winds along the North Carolina coast. Maximum velocity, NE. 36 miles at Cape Henry. Thunder-storms continued in Louisiana and Georgia.

No. XI.—During the 23rd this storm produced only light snows in Minnesota and the Lake region, and brisk to high southerly winds, veering to northwesterly, from the Missouri valley to the Upper Lakes. 24th, as the storm passed eastward the central depression continued diminishing, and it increased in severity. Minimum barometer, 29.17 in. at Sydney, morning of the 25th. Maximum velocities, Grand Haven, SW. 44; Oswego, NW. 34; Eastport, NW. 36; Mt. Washington, NW. 120; Thatcher's Island and Wood's Holl, NW. 40; Sandy Hook, NW. 48; Cape May, NW. 54; Cape Henry, W. 40. Signals were displayed at Cape May, Sandy Hook, and from Boston to Eastport, and should have been ordered for all the stations from North Carolina to Maine.

No. VII.—On the 25th, it appeared as a slight depression to the north of the Upper Lakes. The 26th, it either disappeared into Canada or united with a second, which was central over Lake Superior during the afternoon. Brisk and occasionally high southerly to westerly winds, with clear weather, were produced in the Lake region. The 27th, it crossed New England, accompanied by snow from the northern portion to the St. Lawrence valley, New Brunswick and Nova Scotia, and succeeded by brisk and high southwest winds veering to northerly. Maximum velocities: Grand Haven, SW. 29; Erie, SW. 30; Buffalo and Sandy Hook, SW. 28; Boston, W. 28. Signals were ordered for Grand Haven, Milwaukee, the New Jersey and New England coasts. The majority of those at the coast stations were not justified. On the 28th, as the pressure increased, the winds shifted to northerly along the North Carolina coast, and increased at Kittyhawk to N. 34 miles, for which signals had been ordered.

No. XIII.—This depression was of slight interest, and apparently dissipated in the Upper Lake region.

No. XIV.—On the 28th, rainy weather prevailed along the California coast, with high southerly winds at San Diego and a thunder-storm in San Bernardino county. 29th, light rain fell at Santa Fe and light snow at Salt Lake City. At 7:35 a. m., 30th, it was central in eastern Nebraska. During the day, as it progressed northeastward, rainy weather accompanied it from Indian Territory to Minnesota, Wisconsin and Lake Michigan. The 31st, light rains fell from the Ohio valley to the Lakes. Signals displayed at Milwaukee and Grand Haven were justified; maximum velocity at latter, S. 30 miles.

*Vessels experiencing Storms.*—3rd, Province of Guipuseoa, Spain, hurricane. 4th, lat. 40° 43' N., long. 62° 07' W., h'vy WNW. gale; off Bermuda, h'vy SE. gale lasting 15 hours, then to SW. for 24 hours; hurricane at Santander, Spain. 5th, 32° 20' N., 72° 20' W., WNW. gale for 12 hours; 41° N., 48° W., h'vy gale. 6th, 46° 09' N., 42° 03' W., hard N. gale with h'vy squalls; 44° 03' N., 51° 31' W., very strong WNW. gale; 44° N., 35° W., severe gale; 44° N., 31° W., hurricane. 7th, 26° 40' N., 25° 49' W., strong SE. to WNW. gale; 400 miles NW. of the Azores, ship Dakota destroyed by lightning. 9th, at



Gibraltar, hurricane. 12th, Gulf of Lyons, France, furious gale. 13th, 46° 30' N., 41° W., h'vy W. gale; 48° 08' N., 25° 40' W., to 46° 50' N., 32° 55' W., h'vy WSW. to NNW. gale, with squalls of hurricane force, lasting until 17th. 14th, near 36° 36' N., 38° 09' W., hurricane. 16th, 47° 47' N., 35° 05' W., h'vy W. and N. gale, with very high sea; 45° 56' N., 31° 35' W., h'vy W. gale and h'vy sea; 45° 50' N., 34° 44' W., h'vy WNW. to SW. storm, with furious squalls and tremendous sea. 17th and 18th, 49° 08' N., 22° 02' W., to 49° 50' N., 26° 31' W., strong W. gale and high sea. 24th, 45° 40' N., 45° 30' W., h'vy NW. gale. 25th, long, 66° W., from Havre to New York, violent NW. gale. 26th, 41° 40' N., 60° W., h'vy NW. gale and high sea with snow.

## TEMPERATURE OF THE AIR.

The isothermal curves and figures upon chart No. II illustrate the general distribution of the temperature of the air for the present month. A reference to the table in the lower left-hand corner of the same chart will show that the average is above that for years along the Pacific coast; it is below for all the other districts, especially the Lower Lake region, Middle Atlantic States and St. Lawrence valley. This low average temperature is due to the fact that, while the weather was extremely cold at the beginning of the month, the high pressure-areas, as they passed eastward, covered the entire country, and the low pressure-areas moved well to the southward. The latter part of the month the pressure continued high in the Southern States, and the low pressure-areas crossed the northern portion of the country, especially the Lake region, producing warm, southerly winds and the mild weather which was generally experienced. At Cloverdale, Cal., the freeze of the 13th only injured the tops of the most delicate plants. During the first days of the month large numbers of fish were frozen to death at Milton, Fla.

*Maximum and minimum temperatures*, respectively, for the month, are given, viz: In Maine, Orono, 40°, -32°; Cornish, 46°, -11°; N. H., Mt. Washington, 28°, -36°; Contoocookville, 47°, -23°; Vt., Woodstock, 46°, -27°; Burlington, 43°, -16°; Mass., Billerica, 44°, -15°; Boston, 50°, 2°; R. I., Chepachet, 48°, 4°; Newport, 44°, 7°; Conn., Colebrook, 46°, -6°; New Haven, 48°, 4°; N. Y., Malone, 48°, -25°; Hudson, 56°, -5°; N. J., Salem, 54°, -4°; Ateo, 55°, 3°; Penn., Tioga, 46°, -20°; Brownsville, 57°, 2°; Del., Milford, 60°, -4°; Dover, 58°, 0°; Md., Woodstock, 53°, -10°; Fort McHenry, 65°, -3°; D. C., Washington, 61°, -3°; Va., Snowville, 63°, -8°; Norfolk, 73°, 16°; W. Va., Salem, 60°, -8°; Weston, 60°, -2°; Ohio, Westerville, 50°, -24°; Kenton, 65°, -21°; Ind., Laconia, 66°, -21°; Spiceland, 56°, -22°; Ill., Riley, 44°, -21°; Anna, 72°, 0°; Mich., Alpena, 49°, -14°; Lansing, 50°, -6°; Wis., Neillsville, 44°, -27°; Embarras, 51°, -17°; Minn., Fort Ripley, 44°, -41°; Duluth, 51°, -27°; Iowa, Independence, 49°, -28°; Keokuk, 58°, -9°; Mo., Corning, 63°, -18°; Wet Glaz, 67°, -11°; Neb., De Sota, 56°, -22°; Omaha, 59°, -16°; Kan., Council Grove, 60°, -14°; Sedgewick, 64°, -4°; Ky., Nicholasville, 62°, -12°; Louisville, 66°, -9°; Tenn., Anstin, 64°, -20°; Memphis, 68°, 6°; Ark., Mt. Ida, 68°, 1°; Monticello, 71°, 10°; N. C., Murphy, 62°, -16°; Weldon, 75°, 6°; S. C., Spartansburg, 64°, 0°; Aiken, 75°, 17°; Ga., Atlanta, 72°, 4°; St. Marys, 84°, 26°; Fla., Milton, 75°, 20°; Key West, 90°, 50°; Ala., Carlowville, 74°, 13°; Montgomery, 74°, 16°; Miss., Vicksburg, 73°, 16°; Brookhaven, 76°, 26°; La., Baton Rouge, 78°, 18°; Lake Charles, 78°, 23°; Tex., Mesquite, 73°, 8°; Fort McKavett, 80°, 14°; Ind. Ty., Fort Gibson, 70°, 0°; Fort Sill, 64°, 14°; N. M., Fort Union, 67°, 0°; Santa Fe, 53°, 6°; Col., Fort Lyon, 45°, -19°; South Pueblo, 62°, -9°; Wy. Ty., Fort Sanders, 43°, -22°; Cheyenne, 50°, -14°; Dak. Ty., Pembina, 40°, -53°; Yankton, 51°, -19°; Utah, Coalville, 50°, -30°; Salt Lake City, 50°, 3°; Nev., Camp McDermit, 48°, 0°; Carson City, 65°, 1°; Cal., Salinas City, 77°, 21°; El Monte, 86°, 34°; Or., Portland, 58°, 27°.

*Ice.*—At Decatur, Ala., Tennessee river frozen over 2nd to 4th, ice 2 in. thick, navigation suspended three days. Albemarle, N. C., on Pedee river, in eddies, 4 in. thick, 15th; Lenoir, ponds and streams were frozen 3 to 8 in. Snowville, Va., 18 in. thick, (unheard of before.) Salem, N. J., creek remains firm 31st; has been 15 to 18 in. thick. Philadelphia, Pa., on the Schuylkill, reported 34 in. thick 25th. Wappinger's Falls, N. Y., pond ice reported 30 in. thick 6th, and 36 in. 31st; Malone, pond ice 30 in. thick 13th. Morgantown, W. Va., 8 to 15 in. thick 13th. Wooster, O., 24 in. thick. Afton, Ia., pond ice 14 in. thick 25th; Keokuk, river ice 20 to 30 in. 13th; Independence, river ice 21 in. Leavenworth, Kan., 15 in. thick 8th. Omaha, Neb., 24 in. thick 31st; Plattsmouth, 24 to 30 in. thick 13th. La Crosse, Wis., river ice 13 in. thick 31st. Breckenridge, Minn., on Red River of the North, 40 in. thick, and on the Bois des Sioux 43 in. 31st.

*Frost in the ground.*—It has been reported as frozen to a depth of 5 inches at Brookhaven, Miss., on the 1st; Alta Vista, Va., 7 in., 6th; Danville, Ky., 1 ft., 9th; College Hill, (near Cincinnati,) O., 3½ ft., 13th; Freehold, N. J., 14 in., 29th; Breckenridge, 6 ft. 4 in., 30th; Dover, Del., 30 in., at close of month; Tabor, Ia., 4 ft.; Independence, Ia., 18 in.; Creswell, Kas., 1 ft.; Sedgewick, Kas., 10 in.; Fallston, Md., 7 in.; Somerset, Mass., 14 in.; Wooster, O., 1 ft.; North Lewisburg, O., 16 in. Owing to the heavy covering of snow the frost had penetrated the ground only to a depth of 8 inches at Ardenia, N. Y.; at Westboro, Mass., the ground under the snow was reported free of frost.

## PRECIPITATION.

Upon chart No. III is represented the amount of rain-fall and melted snow. At Jacksboro, in northern Texas, several sprinkles were reported, but not sufficient to measure; same from Ft. McKavett, northwest of San Antonio, Texas. Stations reporting less than one-tenth of an inch: Wickenburg, A. T., 0.01; Maricopa, A. T., 0.08; Yuma, Cal., 0.09; Ft. Larned, Ks., 0.08; Breckenridge, 0.03; Pembina, 0.06.

*Total snow-fall* during the month: For northern New England it varies from 14 to 31 inches; southern New England, 9 to 24; New York, 11 to 48; Middle Atlantic States, 1 to 26; Lower Lake region, 9 to 35; Upper Lake region, 4 to 37; Ohio valley, 4 to 21; Tenn., 5 to 17; N. Car., 1.5 to 22; Miss. and La., 2 to 15; Arkansas, 1 to 4; Upper Miss. valley, 4 to 17; Lower Mo. valley, 4 to 21. *Depth of snow at close of month*: northern New Eng., 24 to 44 inches; southern New Eng., 4 to 20; Middle States, 0 in southern portion to 32 in northern New York; Lower Lake region, 0 in western portion to 32 in eastern portion; lower Ohio valley, none; the Northwest, none in southern portions, 4 in in southern Minn. and southeastern Dakota.

*Cloudy Days*.—The number of days on which the cloudiness has averaged eight-tenths or more, as reported by the Voluntary Observers, ranges for New England from 5 to 13; Middle States, 5 to 17; South Atlantic States, 4 to 13; Gulf States, 5 to 17; Ohio valley to the Upper Lake region, 5 to 20; the Northwest, 2 to 15.

The number of days on which *rain or snow* has fallen, ranges as follows for the Signal Service stations: New England, 7 to 18; Middle Atlantic States, 10 to 16; South Atlantic States, 6 to 16; Eastern Gulf States, 9 to 16; Western Gulf States, 8 to 18; Ohio valley and Tennessee, 12 to 17; Lower Lake region, 14 to 23; Upper Lake region, 4 to 23; Northwest, 4 to 12; Rocky Mountains stations, 5 to 14; California coast, 6 to 9. Along the Lakes the precipitation in the form of snow has frequently been very light, and at times not sufficient to measure. During severe snow storms it is a difficult task to measure the precipitation, therefore Chart No. III is only an approximation for the northern sections of the country.

*Droughts*.—Scarcity of water at Keokuk on the 4th. Dumbarton and Contoocookville, N. H., water very scarce, some farmers being compelled to melt snow to get water for stock. Pennville, Pa., during first half of month, streams very low. West Charlotte, Vt., drought continued all the month; no rain until February 1st. North Argyle, N. Y., drought not allayed 18th.

## RELATIVE HUMIDITY.

The average relative humidity for the month, as reported from the Signal Service stations, ranges as follows: in New England, 69 to 79 per cent; Middle Atlantic States, 73 to 84; South Atlantic States, 72 to 83; Gulf States, 70 to 80; Indian Territory, Arkansas, Tennessee and the Ohio valley, 67 to 76; Lower Lake region, 72 to 80; Upper Lake region, 67 to 82; Northwest, 66 to 79; plains of Kansas and Nebraska, 74 to 81; Rocky Mountain stations, 47 to 75; San Diego and San Francisco, 66; Portland, Or., 74; Mt. Washington, 87.

## WINDS.

*Prevailing Winds*.—These are shown upon Chart No. II, the arrows flying with the wind. At Fort Sully they have blown most frequently from the NW.; Portland, Or., S. The *maximum* hourly velocities have been given in the description of the movements of high and low pressure-areas.

*Total Movements of the Air*.—The following are the largest total movements, as recorded at the Signal Service stations: Pike's Peak, 19,663 miles; Thatcher's Island, 12,084; Sandy Hook, 11,372; Cape May, 11,213; Cape Lookout, 10,960; Kitty Hawk, 10,720; Grand Haven, 10,096; Cheyenne, 10,052. The smallest movements have occurred at the following stations: Nashville, 1,889 miles; Lynchburg, 2,031; Augusta, 2,153; Shreveport, 2,741; San Diego, 2,816; Baltimore, 2,903; Knoxville, 2,929. On Mt. Washington it has been impossible to obtain a continuous record.

## VERIFICATIONS.

*Indications*.—As worked up three times daily, and issued to the public, they have been carefully compared with the actual conditions during the succeeding twenty-four hours, and the following result obtained, viz: the percentage verified averages 91.8 for New England; 89.0, Middle States; 85.4, South Atl. States; 84.8, Eastern Gulf States; 85.5, Western Gulf States; 88.0, Ohio valley and Tennessee; 90.5, Lower Lake region; 88.1, Upper Lake region; 89.0, Upper Miss. valley; 89.0, Lower Mo. valley. For the whole country the average verified is 88.2 per cent. There were 7 omissions to predict out of 3,721, or 0.18 per cent.

*Cautionary Signals*.—Grand Haven and Milwaukee are the only stations along the Lakes at which signals were displayed, owing to the suspension of navigation. Out of 229 ordered to be displayed along Lake Michigan, the Atlantic and Gulf coasts, 172 were justified, 13 were lowered too soon, 1 was ordered late, and 57 were reported not justified. From scattered stations 27 cases were reported, in which the hourly wind velocity reached 25 miles and over, without the display of signals, except on the 24th from the Middle Atl.

and New England coasts, when high westerly winds prevailed at nearly all of them, while signals had been ordered for the exposed stations alone.

## NAVIGATION.

*Height of Rivers.*—Upon chart No. III is a table giving the highest and lowest water-marks, with the dates upon which they occurred. The *Red river* rose slowly, but steadily, at Shreveport, from 4 ft. 5 in., 1st, to 11 ft. 8 in., 31st. In the *Arkansas*, at Little Rock, the fluctuations were very slight, and the water continued low; it was frozen over the 8th. The *Missouri* and *Upper Mississippi* continued frozen over and low the entire month. *Lower Mississippi.*—Navigation suspended between Memphis and Cairo till the 14th, when the ice-gorges passed off. Below Cairo the rise continued to the close of the month, due to the water from the Ohio, Cumberland and Tennessee rivers. From Cairo to St. Louis the ice blockade continued at the end of the month. *Cumberland.*—The ice-gorges below Nashville moved down on the 10th and 11th, after which navigation was resumed. *Tennessee.*—At Paducah the ice-gorge moved out into the Ohio the 15th. *Alleghany.*—Closed during the month. *Monongahela.*—Ice-gorges passed off on the 13th and 14th, with great destruction. *Ohio.*—At Cairo the river was clear on the 12th. The ice-gorges moved some on the 9th at Ironton, O.; 12th and 13th, at Cincinnati. On the 14th there was a general movement of the ice from Pittsburgh to Paducah, which commenced passing Cairo the 15th, after which the resumption of navigation took place. The loss of property above Louisville was very heavy in the shape of steamers, barges, coal, &c. *Potomac.*—At Georgetown, D. C., the ice-gorge gave way the 18th, damaging vessels and property along the banks. *Hudson.*—At Garrison's, opposite West Point, has remained open, but above and below teams cross on the ice.

## TEMPERATURE OF WATER.

As heretofore, the maximum and minimum temperatures alone, with the average depth of the water, are given in the table on chart No. II.

## ATMOSPHERIC ELECTRICITY.

*Thunder-storms.*—1st, Daytona, Fla.; St. Mary's, Ga. 7th, Howard, Neb. 8th and 12th, Fayette, Miss. 14th, Santa Fe; Sedgewick, Kan. 15th, St. Louis; Anna, Ill.; Brookhaven, Miss.; Weldon, N. C.; Jackson, Tenn. 17th, Mobile; Fayette, Miss. 18th, Montgomery. 20th, Galveston. 21st, Charleston; Galveston; Tybee Island, Ga.; New Orleans. 22nd, Tybee Island; New Orleans; Fayette, Miss. 23rd, Aiken, S. C. 25th, Melissa, Tex. 28th, San Bernardino, Cal. 30th, Stanley, Kan.; Starkey, N. Y.; Oregon, Mo.

*Distant Lightning.*—13th, Fayette, Miss. 17th, Montgomery. 19th, Jackson, Tenn. 20th, Atlanta, Ga. 21st, Savannah. 27th, Portsmouth, N. C.

*Auroras.*—6th, Cornish, West Waterville, Surry, Gardiner, Standish and Orono, Me; St. Paul, Duluth, Breckenridge and Minneapolis, Minn.; Malone, N. Y.; Fort Pembina and Bismarck, Dak.; West Charlotte, Vt. 7th, Gardiner, Me.; Minneapolis, St. Paul and Duluth, Minn.; Escanaba; St. John's, N. F. 8th, Escanaba. 13th, Wappinger's Falls, N. Y. 14th, Gardiner, Me.; Waltham, Mass.; North Argyle, N. Y.; Fort Pembina, Dak. 15th, Duluth; Fort Pembina, Dak. 16th, Fort Brady, Mich. 19th, Denver. 20th, Hillsboro, Ohio.

*Electric Ground Currents.*—The observer at Barnegat, N. J., reports strong electric currents on the 17th; the telegraph line was working at 6 p. m., although grounded north and south.

## OPTICAL PHENOMENA.

*Solar Halos.*—1st, Iowa, Minn., N. H., N. Y., Penn. 2nd, Iowa, N. Y., Penn. 3rd, Ill., N. Y. 4th, Me., Neb., Vt. 5th, Dak., Ill., Ind., Mich., Minn., Neb., N. Y., Ohio. 6th, Cal., Ill., Mass., Mich., N. Y., Ohio, Vt. 7th, Iowa, La., Minn., Miss., Neb. 8th, Dak., Ill., Mass., Minn., N. H., R. I. 9th, Conn., Ind., Mich., Minn., Neb., Ohio, Penn. 10th, Mass., Minn., R. I., Tenn. 11th, Iowa, Me., Mass., Neb., N. H., N. J., N. Y., Penn. 12th, Me., Neb., N. J., N. Y., Vt. 13th, N. H., Vt. 14th, Dak., Ill. 15th, Col., Dak., Ga., Iowa, Neb., S. C. 16th, Dak., Ga., Ill., Mich., S. C. 17th, Me., Minn., Neb., N. H., N. Y., R. I. 18th, Minn., Neb. 19th, Col., Dak., N. Y., Va. 20th, Dak., Ga., Iowa, Minn., Neb. 21st, Iowa, Kan., Minn., Neb., N. Y., Ohio, S. C. 22nd, Col., Ind., Ohio. 23rd, Can., Iowa, Minn., Penn. 24th, Iowa, N. Y. 25th, N. J., N. C., Ohio, S. C., Vt. 26th, Me., N. H., Vt. 27th, Ill., Texas. 28th, Ill., Me., N. H., N. Y., Tenn., Vt. 29th, Ill., Mich., Minn., N. Y., Tenn. 30th, Ill., Ind., Mich., Ohio. 31st, Ala., Me., Minn., Miss., N. H., N. Y., Tenn.

*Lunar Halos.*—1st, Dak., Iowa, Penn., Tenn., Va. 2nd, Ill., Iowa, Minn., N. Y., N. C., Tenn., Wis. 3rd, Dak., Iowa, Ohio, Tenn. 4th, Vt. 5th, Ind., Mo., Neb., N. J., Ohio, Tex. 6th, Cal., Mass., N. H.,



N. J., N. Y., Ohio. 7th, Neb. 8th, Del. 18th, Dak., Mass., Minn., N. Mex. 19th, Conn., Dak., Kan., Mass., Minn., Mich., N. C., R. I. 20th, Ark., Conn., Ga., Ky., Mass., Minn., Mo., N. J., N. C., Ohio, Tenn. 21st, Conn., Fla., Ind., Iowa, Me., Mass., Mich., Minn., Neb., N. H., N. Y., Ohio, Penn., R. I. 22nd, Dak., Ind., Me., Mass., N. H., N. J., N. Y., Ohio, Penn., Tenn., Vt. 23rd, Cal., Can., Ill., Iowa, Me., Mo., N. J., N. Mex., N. Y., Va. 24th, Cal., Can., Iowa, Kan., Minn., Mo., Neb., N. Mex., N. C. 25th, Cal., Conn., Ga., Iowa, Kan., Mass., Mo., N. H., N. J., N. Y., N. C., Ohio, R. I., S. C., Tenn., Vt. 26th, Cal., Ind., Iowa, Me., Mass., Mich., Miss., Mo., N. J., N. Mex., N. Y., Tenn., Wis. 27th, Ala., Cal., Iowa, Mass., Mich., Minn., Mo., N. J., N. C., Or., R. I., Tex. 28th, Ala., Iowa, Kan., Me., Mass., Mo., Mont., N. J., N. Mex., N. Y., N. C., Penn., Tex., Wis. 29th, Ala., Cal., Ind., La., Me., Mass., Mich., Min., N. C., Ohio, Tenn., Wis. 30th, Conn., Minn., Ohio, N. C., Tex., Va. 31st, Ala., Can., Del., Ind. Ty., Miss., N. C., S. C., Tex., Tenn., La.

*Mirage*.—Ga., Tybee Island, 3rd, 4th, 5th; Neb., Genoa, 4th, 24th, 26th; Me., Standish, 11th, 17th, 26th, 31st; Minn., Breckenridge, 15th, 22nd, 25th, 27th; Mass., New Bedford, 28th.

### MISCELLANEOUS PHENOMENA.

*Zoological*.—*Wild geese* were observed at Baxter Springs, Kan., 5th and 6th, and flying south 29th; Sedgwick, Kan., NE., 22nd; Melissa, Texas, S., 5th and 30th, N., 27th; Nashville, E., 18th; Corning, Mo., 25th; Abington, Ill., N., 29th; Havana, Ill., abundant three last days of month; Afton, Iowa, and Benettsville, Ky., N., 31st. *Wild ducks*, Fort Macao, N. C., flying S., 19th and 24th; New Bedford, Mass., seen in large numbers 29th and 30th; Golden, Col., and Stanley, Kan., N., 30th; Havana, Ill., abundant three last days of month. *Bluebirds* seen at Weldon, N. C., 14th; Benettsville, Ky., 16th; Austin, Tenn., 26th; Chambersburg, Pa., 27th; Cleveland, Tenn., 28th; Accotink, Va., and Fallston, Md., 29th; Baxter Springs, Kan., and Morgantown, W. Va., 31st; Ringgold, Ohio, during last of month. *Robins* appeared at Morgantown, W. Va., 23rd; Lynchburg, Va., 28th; Fort Madison, Iowa, 30th; Afton, Iowa, 31st. *Redbirds* appeared at Alto Vista, Va., 10th; Morgantown, W. Va., 23rd. *Blackbirds* seen at Golden, Col., flying NW., 31st. *Mockingbirds* appeared at Welborn, Fla., 23th. *Golden Winged woodpecker* seen at Abington, Ill., 31st. *Bees* were out at Afton, Iowa, and Oregon, Mo., 31st. *Reptiles*.—Concerning the reported shower of snakes at Memphis on the 15th, the following is taken from the observer's report: "Morning opened with light rain; 10:20 a. m. began to pour down in torrents, lasting fifteen minutes, wind SW.; immediately after the reptiles were discovered crawling on the sidewalks, in the road, gutters and yards of Vance street, between Landerdale and Goslee streets, two blocks; careful inquiry was made to ascertain if anyone had seen them descend, but without success; neither were they to be found in the cisterns, on roofs, or any elevations above the ground; Vance street is comparatively new, has no pavements, gutters merely trenches; I heard of none being found elsewhere; when first seen they were a very dark brown almost black; were very thick in some places, being tangled together like a mass of thread or yarn."

*Meteors*.—1st, Ky. 3rd, Conn., Penn. 4th, Mo. 5th, N. Y. 7th, Iowa. 8th, N. C. 9th, Penn. 13th, N. J. 15th, Iowa, W. Va. 20th, Ky. 23rd, Ohio. 24th, Mass., N. J. 26th, Fla. 27th, Iowa, La. 30th, Ky., Penn.

*Ice-bergs*.—Lat., 44° 15' N., long., 44° 40' W., 23rd.

*Polar Bands*.—Me., Gardiner, 1st, 8th, 12th, 21th, 27th. Wis., Milwaukee, 2nd. Va., Wytheville, 3rd, 23rd, 31st. Ga., Tybee Island, 5th, 8th. Ohio, Carthage, 6th, 9th, 14th, 18th, 21st, 25th, 27th. Fla., Daytona, 11th. Iowa, Guttenburg, 12th, 29th; Iowa City, 13th, 25th, 27th; Tabor, 31st. Minn., Duluth, 17th, 23rd, 24th, 25th; St. Paul, 26th. Ky., Benettsville, 25th. N. H., Contoocookville, 31st.

*Zodiacal Light*.—Ga., Savannah, 2nd, 4th, 30th. Mass., Somerset, 4th, 5th, 7th, 9th. Florida, 5th. Ohio, Bellefontaine, 4th, 5th, 14th, 17th, 31st. N. J., Ateo, 4th, 9th. N. Y., Waterburgh, 5th, 13th, 17th.

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Albert J. Meyer

Brig. Gen. (Bvt. Assg<sup>d</sup>.) Chief Signal Officer, U. S. A.

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